IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:	Group Art Unit: 2624
Hassan Mostafavi	Examiner: Allison, Andrae S.
Serial No.: 10/656,478	Confirmation No. 8695
Filed: September 5, 2003	
For: SYSTEMS AND METHODS FOR TRACKING MOVING TARGETS AND MONITORING OBJECT POSITIONS	

Mail Stop AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO OFFICE ACTION

Dear Sir:

    In response to the Office Action mailed on June 13, 2007, Applicant amends the above-identified application as follows.

    Amendments to the Claims begin on page 2.

    Remarks begin on page 9.

AMENDMENTS TO THE CLAIMS

Please amend claims 1, 22, 31, 40, 50, and 53, as follow. A complete listing of the current pending claims is provided below and supersedes all previous claims listing(s).

1. (Currently Amended) A method of determining a position of a target region in a medical procedure, comprising:

acquiring an input image of a target region;

enhancing a feature of the input image based on a motion of a moving object, wherein the act of enhancing is performed such that an image of a~~the~~ moving object is enhanced relative to an image of a relatively stationary object;

registering the input image with a template; and

determining a position of the target region in the input image based on the registering.

2. (Original) The method of claim 1, wherein the enhancing comprises determining a composite image of previously acquired input images.

3. (Original) The method of claim 2, wherein the determining a composite image comprises performing an image averaging on the previously acquired input images.

4. (Original) The method of claim 2, wherein the enhancing further comprises subtracting the composite image from the input image.

5. (Original) The method of claim 3, wherein the image averaging is performed using a boxcar averaging technique.

6. (Original) The method of claim 3, wherein the image averaging is performed based on a weighted average.

7. (Original) The method of claim 1, further comprising selecting the template from a plurality of templates.

8. (Original) The method of claim 7, wherein the selecting comprises choosing a template from the plurality of templates that best matches at least a portion of the input image.

9.   (Original) The method of claim 7, wherein the selecting comprises:

comparing the input image with at least a subset of the templates; and

selecting the template that best matches at least a portion of the input image.

10.   (Original) The method of claim 7, wherein the selecting comprises comparing the input image with the template that is generated at approximately a same time-point or a same phase of a physiological cycle as the input image.

11.   (Original) The method of claim 7, wherein the selecting comprises:

determining a previously registered template; and

comparing the input image with the template next in line to the previously registered template.

12.   (Original) The method of claim 1, wherein the determining a position of the target region comprises determining a position of the image in the input image that best matches the template.

13.   (Original) The method of claim 1, wherein the input image comprises a fluoroscopic image.

14.   (Original) The method of claim 1, further comprising performing a medical procedure based on the determined position of the target region.

15.   (Previously Presented) The method of claim 14, wherein the medical procedure comprises directing a radiation beam to the target region.

16.   (Original) The method of claim 15, wherein the performing the medical procedure comprises changing a direction of a radiation beam in response to the determined position.

17.   (Original) The method of claim 15, wherein the performing the medical procedure comprises gating a delivery of the radiation beam in response to the determined position.

18.   (Original) The method of claim 1, wherein the target region comprises at least a part of an animal body.

19.   (Original) The method of claim 18, wherein the at least a part of an animal body comprises a lung tissue or a heart tissue.

20.   (Original) The method of claim 18, wherein the at least a part of an animal body comprises a bone.

21.   (Original) The method of claim 1, wherein the target region comprises at least a part of a non-animal object.

22.   (Currently Amended) A system for determining a position of a target region in a medical procedure, comprising:

    means for acquiring an input image of a target region;

    means for enhancing a feature in the input image based on a motion of a moving object, wherein the means for enhancing performs the act of enhancing such that an image of a̶the moving object is enhanced relative to an image of a relatively stationary object;

    means for registering the input image with a template; and

    means for determining a position of the target region in the input image based on the registering.

23.   (Original) The system of claim 22, wherein the means for enhancing comprises means for determining a composite image of previously acquired input images.

24.   (Original) The system of claim 22, further comprising means for selecting the template from a plurality of templates.

25.   (Original) The system of claim 24, wherein the means for selecting comprises means for choosing a template from the plurality of templates that best matches an image in the input image.

26.   (Original) The system of claim 22, wherein the means for acquiring an input image comprises means for generating a fluoroscopic image.

27.   (Original) The system of claim 22, further comprising means for performing a medical procedure based on the determined position of the target region.

28.   (Previously Presented) The system of claim 27, wherein the means for performing the medical procedure comprises means for directing a radiation beam to target region.

29.   (Original) The system of claim 28, wherein the means for performing the medical procedure comprises means for changing a direction of a radiation beam in response to the determined position.

30.   (Original) The system of claim 28, wherein the means for performing the medical procedure comprises means for gating a delivery of the radiation beam in response to the determined position.

31.   (Currently Amended) A computer readable medium having a set of stored instructions, the execution of which causes a process to be performed, the process comprising:

acquiring an input image of a target region;

enhancing a moving feature in the input image <u>based on a motion of a moving object, wherein the act of enhancing is performed</u> such that an image of a moving object is enhanced relative to an image of a relatively stationary object;

registering the input image with a template; and

determining a position of the target region in the input image based on the registering.

32.   (Original) The computer readable medium of claim 31, wherein the enhancing comprises determining a composite image of previously acquired input images.

33.   (Original) The computer readable medium of claim 31, wherein the process further comprising selecting the template from a plurality of templates.

34.   (Original) The computer readable medium of claim 33, wherein the selecting comprises choosing a template from the plurality of templates that best matches an image in the input image.

35.   (Previously Presented) The computer readable medium of claim 31, wherein the input image comprises a fluoroscopic image.

36.   (Previously Presented) The computer readable medium of claim 31, wherein the process further comprising performing a medical procedure based on the determined position of the target region.

37.   (Previously Presented) The computer readable medium of claim 36, wherein the medical procedure comprises directing a radiation beam to the target region.

38.   (Original) The computer readable medium of claim 37, wherein the performing the medical procedure comprises changing a direction of a radiation beam in response to the determined position.

39.   (Original) The computer readable medium of claim 37, wherein the performing the medical procedure comprises gating a delivery of the radiation beam in response to the determined position.

40.   (Currently Amended) A method of monitoring a position of an object, comprising:

         providing a reference image of the object;

         acquiring a first image of the object;

         determining a first composite image based on the reference image and the first image by performing a subtraction function; and

         determining whether the object has moved based at least on the first composite image.

41.   (Previously Presented) The method of claim 40, further comprising determining a first value associated with a contrast of the first composite image.

42.   (Previously Presented) The method of claim 41, wherein the determining whether the object has moved is performed based on the first value.

43.   (Original) The method of claim 40, further comprising:

         acquiring a second image of the object;

         determining a composite image based on the second image and the reference image; and

         determining whether the object has moved based at least on the second composite image.

44. (Original) The method of claim 43, further comprising determining a second value associated with a contrast of the second composite image.

45. (Original) The method of claim 44, wherein the determining whether the object has moved is performed based on the second value.

46. (Original) The method of claim 40, wherein the object comprises at least a portion of an animal body.

47. (Original) The method of claim 46, wherein the at least a portion of an animal body comprises a bone.

48. (Original) The method of claim 40, wherein the first image comprises a fluoroscopic image.

49. (Original) The method of claim 40, further comprising enhancing a moving object in the first image.

50. (Currently Amended) A system for monitoring a position of an object, comprising:

   means for providing a reference image of the object;

   means for acquiring a first image of the object;

   means for determining a first composite image based on the reference image and the first image by performing a subtraction function; and

   means for determining whether the object has moved based at least on the first composite image.

51. (Original) The system of claim 50, further comprising means for determining a first value associated with a contrast of the first composite image.

52. (Original) The system of claim 50, further comprising means for enhancing a moving object in the first image.

53. (Currently Amended) A computer readable medium having a set of stored instructions, the execution of which causes a process to be determined, the process comprising:

providing a reference image of the object;

acquiring a first image of the object;

determining a first composite image based on the reference image and the first image by performing a subtraction function; and

determining whether the object has moved based at least on the first composite image.

54.   (Original) The computer readable medium of claim 53, wherein the process further comprising determining a first value associated with a contrast of the first difference image.

55.   (Original) The computer readable medium of claim 53, wherein the determining whether the object has moved is performed based on the first value.

56.   (Original) The computer readable medium of claim 53, wherein the process further comprising enhancing a moving object in the first image.

57.   (Previously Presented) The method of claim 40, wherein the reference image and the first image are obtained from a same imaging direction relative to the object.

REMARKS

Amendments to claims 1, 22, 31, 40, 50, and 53 are for the purpose of clarifying what Applicant regards as the invention. No new matter has been added.

I.   Claim Rejections Under 35 U.S.C. § 102

Claims 1, 22, and 31

Claims 1-3, 7-9, 12-14, 18, 20, 23-27, and 31-36 stand rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent Application Publication No. 2003/0086596 (Hipp). Applicant respectfully notes that in order to sustain a claim rejection under § 102, each of the claimed elements must be disclosed, either expressly or inherently, in the cited reference.

Claim 1 has been amended to recite enhancing a moving feature in the input image *based on a motion of a moving object*. (Emphasis Added) Claims 22 and 31 have been amended to recite similar limitations. The cited passage (paragraph 35) of Hipp does not disclose or suggest the above limitations. Rather, paragraph 35 of Hipp discloses:

> One goal of the embodiments of the present disclosure is to track the position of a specific vertebra in a sequence of medical images. Accurate tracking relies on rich texture, defined as wide variation in gray levels within and particularly at the boundaries of the vertebra being tracked. Sometimes it's necessary to enhance the features of an image to create greater contrast, better definition of *vertebral edges*, or reduce noise in the search model and/or target images.
>
> (Emphasis Added)

As such, paragraph 35 of Hipp merely discloses enhancing an edge of a vertebrae, and does not disclose or suggest enhancing a moving feature in the input image *based on a motion of a moving object*. Notably, in Hipp, the vertebral edge is enhanced based on the anatomical structure of the vertebrae, and not based on a motion of the vertebrae (i.e., the enhancement is performed even if the vertebrae is not moving). As such, Hipp does not disclose or suggest enhancement based on a motion of a moving object. For at least the foregoing reasons, claims 1, 22, and 31, and their respective dependent claims, are believed allowable over Hipp.

Claims 40, 50, and 53

Claims 40, 43, 46, 49, 50, 53, and 56 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 6,075,557 (Holliman).

Claim 40 has been amended to recite determining a first composite image based on the reference image and the first image *by performing a subtraction function.* (Emphasis Added) Claims 50 and 53 have been amended to recite similar limitations. Holliman does not disclose or suggest the above limitation. Rather, Holliman discloses performing a template matching by finding a position where there is a best correlation between the template and an underlying image area (Step 49 of figure 12). For at least the foregoing reason, claims 40, 50, and 53, and their respective dependent claims, are believed allowable over Holliman.

CONCLUSION

Based on the foregoing, all claims are believed in condition for allowance. If the Examiner has any questions or comments regarding this amendment, please contact the undersigned at the number listed below.

The Commissioner is authorized to charge any fees due in connection with the filing of this document to Bingham McCutchen's Deposit Account No. **50-4047,** referencing billing number **7031422002**. The Commissioner is authorized to credit any overpayment or to charge any underpayment to Bingham McCutchen's Deposit Account No. **50-4047,** referencing billing number **7031422002**.

Respectfully submitted,

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